Table of Contents

Airway
1. High STOP-BANG score indicates a high probability of obstructive sleep apnea ...........................................3
2. Comparative Effectiveness of the C-MAC Video Laryngoscope versus Direct Laryngoscopy in the Setting of the Predicted Difficult Airway.........................................................7

General
1. Multiple reservoirs contribute to intraoperative bacterial transmission ..........................................................11

Pediatric Anesthesia
1. A meta-analysis of the use of nonsteroidal anti-inflammatory drugs for pediatric postoperative pain .......................15

Pharmacology
1. Nitrous oxide and long-term morbidity and mortality in the ENIGMA trial .........................................................18
2. Preoperative dexamethasone enhances quality of recovery after laparoscopic cholecystectomy .............................22
Indicates Continuing Education Credit is available for this abstract and comment during the CE approval period. Continuing Education Credit is available to individual subscribers on the Anesthesia Abstracts web site at www.AnesthesiaAbstracts.com.

New health information becomes available constantly. While we strive to provide accurate information, factual and typographical errors may occur. The authors, editors, publisher, and Lifelong Learning, LLC is/are not responsible for any errors or omissions in the information presented. We endeavor to provide accurate information helpful in your clinical practice. Remember, though, that there is a lot of information out there and we are only presenting some of it here. Also, the comments of contributors represent their personal views, colored by their knowledge, understanding, experience, and judgment which may differ from yours. Their comments are written without knowing details of the clinical situation in which you may apply the information. In the end, your clinical decisions should be based upon your best judgment for each specific patient situation. We do not accept responsibility for clinical decisions or outcomes.
High STOP-BANG score indicates a high probability of obstructive sleep apnea

Br J Anaesth 2012;108:768-75
Chung F, Subramanyam R, Sasaki E, Shapiro C, Sun Y

Abstract

Purpose  The purpose of this study was to determine if a high score on the STOP-BANG questionnaire was associated with a higher probability of more severe Obstructive Sleep Apnea (OSA).

Background  OSA is associated with increased perioperative morbidity and mortality. In the United States, OSA affects between 2-26% of the population. Unfortunately, 82% of men and 92% of women with moderate to severe OSA have never been diagnosed. One instrument, the STOP-BANG questionnaire, has been found to be highly sensitive at detecting moderate to severe OSA in patients presenting for surgery who have never been diagnosed. A score of ≥3 indicates the patient is at high risk for OSA. Unfortunately, the false positive rate is fairly high with a cutoff score of ≥3. The investigators hypothesized that a higher score on the STOP-BANG would predict a higher probability of severe OSA.

Methodology  Adults who presented for elective surgery were enrolled in the study. All patients completed the STOP-BANG questionnaire then either had a laboratory or portable polysomnography exam completed prior to surgery. Patients were diagnosed with OSA if the Apnea Hypopnea Index (AHI) was >5 and they reported fragmented sleep and daytime sleepiness. AHI scores of 5-15 indicated mild OSA, scores of 15-30 moderate OSA, and scores >30 severe OSA. Statistical analysis was appropriate and a P < 0.05 was considered significant.

Result  Over a 2 year period 6,369 surgical patients were screened with the STOP-BANG at two hospitals in Toronto, Canada. Only 12% (N = 746) of these patients had complete STOP-BANG and polysomnography data. These 746 patients were included in the analysis. Forty-nine percent (49%) were male, with a median age of 60 years, neck circumference of 39 cm, and a BMI = 30 kg/m². Overall, 68% had some degree of OSA. Most commonly, patients had a STOP-BANG score of either 3 (23%) or 4 (22%). Mild OSA was present in 30%, moderate OSA in 21%, and severe OSA in 18% of patients.

As the STOP-BANG score increased, the specificity increased and the sensitivity decreased. [See comment for definitions of sensitivity & specificity.] When the STOP-BANG score was ≥3 the specificity was only 28% for severe OSA. However, with a STOP-BANG score ≥5 the specificity for severe OSA increased to 74% and with a score of ≥7 the specificity was 96%. Thus, at higher scores (≥5) the STOP-BANG had a low false positive rate for identifying patients with severe OSA.
In contrast, the sensitivity in identifying a patient with severe OSA with a STOP-BANG score of $\geq 3$ was 95%; with a score of $\geq 5$ it was 56%, and with a score of $\geq 7$ sensitivity was only 12%. This low sensitivity result for a cut score of $\geq 7$ indicates the STOP-BANG had a high false negative rate. A previous investigation reported the specificity of a cut score $\geq 3$ to be 37% for severe OSA. In that study the sensitivity for a cut score of $\geq 3$ was 100%. Area under the receiver operator characteristic curve analysis indicated that the STOP-BANG questionnaire was best at discriminating those patients with severe OSA (all OSA = 0.65; severe OSA 0.71).

The odds of any degree of OSA (AHI $> 5$) and of severe OSA (AHI $> 30$) increased as the STOP-BANG score increased (Table 1). For example, a patient with a score of $\geq 7$ was almost 15 times more likely to have severe OSA compared to a patient with a STOP-BANG score $< 3$ ($P < 0.05$). Likewise, the probability of the patient having any degree of OSA or severe OSA increased as the STOP-BANG score increased (Figure 1).

**Conclusion**

In this study, the odds of having any degree of OSA (AHI $> 5$), especially severe OSA (AHI $> 30$), increased as the STOP-BANG score increased. Providers should consider using the STOP-BANG to help stratify patients with unrecognized OSA who need further preoperative diagnosis and treatment. The STOP-BANG can also help identify patients who may need perioperative precautions implemented to prevent complications such as preparation for difficult intubation, using short-acting anesthetics, adequate neuromuscular blockade reversal, and use of continuous positive airway therapy (CPAP) and postoperative monitoring (e.g. SPO$_2$, ETCO$_2$).

**Comment**

The STOP-BANG is one of the simplest preoperative screening tools for OSA. When the instrument was initially developed, a cutoff score of $\geq 3$ was established as indicating the patient was at risk for having OSA. However, it did not tell you about the severity of OSA, which is of clinical import to anesthesia providers. The results suggested that a patient with a higher score on the STOP-BANG had a higher probability of having severe OSA. Before we

<table>
<thead>
<tr>
<th>STOP-BANG score</th>
<th>Odds All OSA (AHI $&gt; 5$)</th>
<th>Odds Severe OSA (AHI $&gt; 30$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3 (1.9-4.7)</td>
<td>3.6 (1.5-8.6)</td>
</tr>
<tr>
<td>4</td>
<td>3.2 (2.0-5)</td>
<td>5.3 (2.3-12.5)</td>
</tr>
<tr>
<td>5</td>
<td>4 (2.4-6.7)</td>
<td>10.4 (4.5-24.3)</td>
</tr>
<tr>
<td>6</td>
<td>4.5 (2.3-8.7)</td>
<td>11.6 (4.6-28.7)</td>
</tr>
<tr>
<td>7 or 8</td>
<td>7 (2.8-17.6)</td>
<td>14.9 (5.6-39.6)</td>
</tr>
</tbody>
</table>

*Note.* Odds ratios & (95% confidence intervals) of OSA for a given STOP-BANG score as compared to a score of $< 3$. AHI = Apnea Hypopnea Index.
take the authors conclusion at face value I believe further clarification of their results is in order.

When examining a diagnostic test it is useful to evaluate the sensitivity, specificity, and area under the curve receiver operator characteristic results. Specificity refers to the ability of the test to correctly identify patients without a disease; in this case without severe OSA. So for a STOP-BANG score of ≥7 the specificity was 96%, which indicates that 4 out of 100 patients with this score would be incorrectly identified as having severe OSA (4% false positive rate). However, the sensitivity at a score ≥7 was 12%, suggesting that 88% of patients who had a score of 7 may not be identified as having severe OSA (88% false negative rate). On the surface these results seem confusing.

**Sensitivity and Specificity** results are relatively crude measures of an instrument’s ability to accurately identify a patient with a disease or condition. However, what one typically sees with tests like the STOP-BANG is that as the cutoff score increases, say from ≥3 to ≥7, there will be fewer false positives but more false negatives. In contrast if the cut score is low, then the test is more sensitive but less specific. With a lower score you may identify more patients who may have OSA who really do not have it. To determine the overall accuracy of the STOP-BANG, one needs to examine the area under the curve receiver operator characteristic results, this takes into account the sensitivity and specificity. For severe OSA the area under the curve was 0.71, which is moderately good. This suggests that a patient with severe OSA will have a 71% chance of having a
higher STOP-BANG score as compared to a patient without severe OSA diagnosed by polysomnography. So these results support the author’s conclusion that a higher STOP-BANG score is associated with a higher likelihood of severe OSA. I think the instrument is good, but not perfect, in identifying patients with OSA, especially those with severe OSA.

How can we apply these results to practice? The authors of this study recommended using a score of $\geq 3$ in patients with high OSA prevalence such as those having bariatric surgery. At this score the false negative rate is pretty low, so you could be confident in excluding severe OSA in a bariatric patient if their STOP-BANG score was $< 3$. However, the authors recommend using a cut score of $\geq 5$ in a general patient population to reduce the false positive rate. This would allow providers to identify those patients who may have moderate to severe OSA that need further workup and treatment, such as starting CPAP therapy, and implementation of perioperative precautions. To me this seems reasonable and may help reduce perioperative complications secondary to OSA. Readers are referred to the September 2011 single topic issue on OSA in Anesthesia Abstracts.

Dennis Spence PhD, CRNA

**NOTE:** Area under the receiver operator characteristic curves plot true positives against the false positives, or the sensitivity against $1 - \text{specificity}$ for all cutoff values. One then examines the area under the curve to calculate the accuracy of a test. A perfect test is one with a score of 1.0, and a test that is no better than tossing a coin is 0.5. It is rare in clinical medicine to have a test with a perfect score.


The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Comparative Effectiveness of the C-MAC Video Laryngoscope versus Direct Laryngoscopy in the Setting of the Predicted Difficult Airway

Anesthesiology 2012;116:629-636
Aziz M, Dillman D, Fu R, Brambrink A

Abstract

Purpose The purpose of this study was to compare the success rate of initial intubation attempts with the C-MAC video laryngoscope vs. a traditional laryngoscope in the population with a predicted difficult airway.

Background It remains uncertain if using a video laryngoscope ensures a high success rate at initial intubation attempts compared to a standard laryngoscope - specifically in the predicted difficult airway population. Use of the video laryngoscope and its associated technology has grown significantly over the past several years. It is now unofficially advocated by providers in attempts to manage a difficult airway. Several studies have provided evidence that video laryngoscopes improve laryngeal view and make intubation easier, especially for the learner. Additionally, it is used successfully as a rescue device when initial attempts at laryngoscopy and intubation have failed. What has not been validated is whether the video laryngoscope can increase intubation success when used by the experienced provider, particularly in the patient with a predicted difficult airway. Are experienced laryngoscopists more successful at initial intubation attempts using a video laryngoscope compared to a traditional laryngoscope?

This is a very relevant question for anesthesia providers. Every attempt at intubation for a single patient increases their risk of significant morbidity and even mortality.

Methodology This was a single blind, two arm, randomized controlled trial comparing the C-MAC video laryngoscope with direct laryngoscopy in individuals with a predicted difficult airway. Practitioners were instructed on the use of the C-MAC video laryngoscope. For three months prior to enrollment of subjects they used the C-MAC laryngoscope for everyday clinical use. Patients were recruited and included in the study if one or more of the following predictors of difficult intubation were identified:

- reduced cervical motion from pathologic condition
- cervical spine precautions
- Mallampati classification score III or IV
- less than 3 cm mouth opening
- history of difficult direct laryngoscopy

The randomization scheme involved a 1 to 1 allocation using computerized software. Initial attempts at intubation were either with conventional laryngoscope blades or the C-MAC system. Patients were blinded to their intubation technique until the postoperative assessment was complete. A standardized induction sequence was used and positioning for airway establishment was according to
physiologic findings. Muscle relaxant was at the discretion of the provider. The obese were ‘ramped up’ and those with cervical spine precautions were managed with manual in-line stabilization. Laryngoscopy was performed only by predefined experienced providers; novices were excluded. The primary outcome measure was defined as intubation success at first attempt verified by E\textsubscript{T}CO\textsubscript{2}. Secondary outcome measures were:

- best Cormack-Lehane laryngeal view
- laryngoscopy time
- use of external laryngeal manipulation
- use of a bougie
- oxygen desaturation
- airway related complications

Any failed attempt was managed at the discretion of the provider. In the recovery room, each patient was examined for signs of airway trauma.

**Result**

A total of 296 airway management procedures were provided by 91 anesthesia providers. Demographic data varied between groups only in regards to thyromental distance of < 6 cm (more common in the C-MAC group) and the type of provider (fewer residents in the C-MAC group). The proportion of success was 93% in the C-MAC group compared with at 84% in the direct laryngoscopy group (P = 0.026). This remained significant even after adjusting for the two differences in the demographic data between groups. Following is the secondary outcome data:

1. Cormack-Lehane laryngeal view was graded I or II in 93% of C-MAC laryngoscopies versus 81% of the direct laryngoscopies (P < 0.01)
2. In successful intubations; laryngoscopy time averaged 46 seconds for the C-MAC group and 33 seconds in the Direct Laryngoscopy group (P < 0.001)
3. The use of a bougie and/or external laryngeal manipulation was required less often in successful C-MAC laryngoscopies compared to successful direct laryngoscopies (P = 0.02)
4. Oxygen desaturation was not statistically significantly different between groups
5. There were very few complications and the incidence of lip/gum/oral trauma, dental trauma, sore throat were not significantly different between groups

**Conclusion**

In a common clinical care environment with a large diverse patient population and several types of anesthesia providers, initial intubation success in the predicted difficult airway patient was more common in the C-MAC video laryngoscopy group compared with a traditional direct laryngoscopy. While the average time to intubate was longer using the C-MAC system, it appeared to be a useful technique for an initial approach to managing and a difficult airway.

**Comment**

We are very fortunate to have the benefit of using the most current technology when we manage an airway, both in emergent and non emergent scenarios. So many of the new airway management products have been specifically designed for use in the patient with a potential difficult airway. For all of us who establish airways as a component of the clinical care we provide, the ability to ventilate and subsequently intubate is one of the most intensely complex procedures we perform, yet it is performed regularly. Failure to establish an airway remains the leading cause of anesthesia related morbidity and mortality, even in this era of sophisticated technology.
I am often impressed with the advances in the technology; they have certainly made my practice safer. However I would be remiss if I failed to discuss the continued importance of the ASA difficult airway algorithm. The algorithm has been established and refined over the years to include not only advances in technology, but it encompasses what we have learned of human anatomy and physiology. The guidelines have been established from sound evidence based procedures. Consider the following general scenario:

An ASA III, middle aged male presents for elective surgery. Pre-anesthesia assessment identifies a Mallampati III airway and a normal thyromental distance. A thick neck is noted and only moderate neck flexion and extension can be elicited. He has no diagnosis of Obstructive Sleep Apnea, yet the patient has been given opioids for pain and is snoring loudly in the preoperative holding area. Oxygen saturation on room air varies between 93% - 95%. After the anesthesia assessment is complete, it is decided to use a video laryngoscope for the initial attempt at endotracheal intubation.

The patient is induced in the operating room. An induction agent is administered and a succinylcholine immediately follows. There is no attempt to ventilate between induction and muscle relaxant. Following loss of consciousness, attempts to ventilate are unsuccessful even with the placement of an oral airway. Seconds pass and oxygen saturation drops precipitously. The video laryngoscope is inserted and vocal cords are viewed, yet attempts to pass the endotracheal tube are unsuccessful. Oxygen saturation continues to decrease, the video laryngoscope is removed, the oral airway reinserted, ventilation attempted, and immediate help called for. With numerous experienced providers now attending to the patient and ventilation increasing oxygen saturation to 95% with multiple providers’ hands involved, the cords are again visualized with the video laryngoscope by another provider. Intubation is again unsuccessful. Attempts with a standard straight blade are unsuccessful as well. Because vocal cords had been visualized using the video laryngoscope, the anesthesia team felt a sense of security that intubation would be successful and more muscle relaxation was given. After more unsuccessful attempts at intubation, the patient was awakened without harm and the procedure postponed. For his subsequent anesthetic, an awake fiberoptic intubation was planned.

In this example, the use of sophisticated technology to visualize the vocal cords during attempts at intubation provided a false sense of security which lead the anesthesia team to deviate from the difficult airway algorithm. While one might argue that ventilation should have been attempted before depolarizing muscle relaxation was administered, if the intubation had been conducted as a true rapid sequence, the same situation would have occurred. What is most concerning is that visualization of the vocal cords while using the video laryngoscope allowed for a false sense of security that an endotracheal tube could be passed. Instead of aborting the procedure because of an inability to easily ventilate, and then an inability to intubate, more muscle relaxant was administered.
The lessons learned from this scenario are monumental. We should use the most advanced technology available, base our plan upon a thorough preoperative assessment, and continue to follow the difficult airway algorithm without being diverted by our assumptions of what new airway technology will do for us. Visualizing the cords does not guarantee success placing the endotracheal tube. Let us not be fooled nor forget to use our technology together with evidence based practice guidelines. Combining the two should offer the greatest safety in patient care.

Mary A Golinski, PhD, CRNA

Manufacturer’s web site for more information on the C-MAC video laryngoscope: http://
www.karlstorz.com/cps/rde/xchg/
SID-288120FD-483BDF71/karlstorz-en/hs.xsl/
9549.htm

The reader is referred to the ASA website for the most current version of the difficult airway algorithm.
General

**MULTIPLE RESERVOIRS CONTRIBUTE TO INTRAOPERATIVE BACTERIAL TRANSMISSION**

Anesth Analg 2012;114:1236-48


**Abstract**

**Purpose** The purpose of this study was to determine the extent to which the hands of anesthesia providers, the patient, and environment contributed to contamination of IV stopcocks in surgical patients. The secondary aim was to identify risk factors for IV stopcock contamination and determine if these risk factors were associated with postoperative infections.

**Background** Healthcare associated infections are a major public health concern. One of the major contributors to these infections is bacterial cross-contamination between health care providers, the environment, and patients. The relative contribution of each of these reservoirs to infections is unknown. Previous investigations have shown that anesthesia provider hands are a frequent source of IV stopcock contamination. However, further research is needed to determine if other bacterial reservoirs, e.g. patient and environment, contribute to stopcock contamination and healthcare-associated infections.

**Methodology** This was a prospective, randomized, observational study at three academic institutions to examine the sources of within-case and between-case IV stopcock contamination. Subjects enrolled included adult patients undergoing general anesthesia. The first two consecutive patients in 274 randomly selected operating rooms were enrolled in the study (N = 548). Bacterial reservoirs cultured included the hands of all anesthesia providers involved in patient care (provider), the patients themselves, the anesthesia machine adjustable pressure-limiting valve (APL), and vaporizer dial (Table 1). (The anesthesia machine APL and vaporizer dials were, together, classified as the “environment.”)

**Table 1. Culture Sampling Sequence**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Active decontamination of anesthesia machine by study personnel prior to first case.</td>
</tr>
<tr>
<td>2.</td>
<td>Baseline cultures of sterile stopcock, APL valve, vaporizer dial, provider hands, and patient (axilla and nasopharynx).</td>
</tr>
<tr>
<td>3.</td>
<td>At end of case 1, cultures obtained from the IV stopcock, APL valve, vaporizer dial, provider hands, and patient.</td>
</tr>
<tr>
<td>4.</td>
<td>Routine decontamination of anesthesia machine by hospital personnel between cases.</td>
</tr>
<tr>
<td>5.</td>
<td>Repeated step 2 and 3 prior to start and again at end of case 2.</td>
</tr>
<tr>
<td>6.</td>
<td>Provider hands were also cultured intermittently throughout patient care, at case end, and upon provider return to the operating room after an absence during the case.</td>
</tr>
</tbody>
</table>

Any bacterium isolated from the IV stopcock was compared with bacterial isolates from the provider, patient, and environment. If the bacteria isolated from the IV stopcock was identical to bacteria isolated...
from one of the three reservoirs (same organism class and biotype), and there was a temporal association, then bacterial transmission was assumed to have occurred. Between-case transmission was defined as the presence of bacteria in the stopcock of case 2 that was identical to that obtained from the stopcock in case 1. Within-case contamination occurred if the bacteria isolated in the stopcock set was identical to one isolated from one of the reservoirs (provider, patient, or environment). Providers were observed for the number of times they decontaminated their hands with hand sanitizer per hour. Providers were also assessed to determine how many times per hour they changed their gloves and the rate of hand decontamination with hand sanitizer after glove removal.

Patients were followed for 30 days postoperatively to determine the incidence of healthcare-associated infections. Bacterial pathogens identified on the reservoirs were compared with the causative organism of any postoperative infection. Statistical analysis was appropriate and significance was considered to be a P value < 0.05.

**Result** Contamination of IV stopcocks was found in 23% of cases (126 out of 548). There were 14 between-case and 30 within-case stopcock transmission events from at least one of the reservoirs; provider, environment, or patient. The most common reservoir source was the anesthesia machine environment (APL valve and/or vaporizer dial), which contributed 64% of the between-case and 47% of the within-case transmission events, respectively (Figure 1). Compared to baseline sampling after active decontamination prior to start of the case, the APL valve became more contaminated by the end of the first case (P = 0.015). In contrast, the vaporizer dial did not have increased bacterial contamination. Provider hands were confirmed as vectors of transmission between the environment and contaminated stopcocks in 27% of all between and within-case transmission events.

Hospital 0 was five times more likely to be associated with IV stopcock contamination than the other two hospitals (P = 0.001). Stopcocks were 7 times more likely to get contaminated during case 2 (P < 0.001). The risk of IV stopcock contamination was reduced if providers increased their use of hand sanitizer (OR = 0.66, P = 0.005). Providers at all three facilities used hand sanitizer on average 0.4 times per hour.

![Figure 1. Stopcock Contamination Transmission Events](image-url)
Providers changed their gloves 2.39 times per hour; however, 40% of the time providers did not wash their hands when gloves were removed.

A total of 44 patients developed postoperative infections (8%). Patients who had surgery at Site 0 were 14 times more likely to develop a healthcare-associated infection (P = 0.002). A higher ASA status (OR = 2.61, P = 0.003) and SENIC score (an index predicting the probability of a postoperative healthcare-associated infection) were both predictors of a healthcare-associated infection (P = 0.017).

Bacterial cultures identified the causative organism in 45% of patients with healthcare-associated infections (20 of 44). In 30% of these patients, the causative organism had been found in at least one of the reservoirs (environment, provider, or patient). In 14% of patients, the bacterial organisms present at the time of surgery caused the healthcare-associated infection (6 of 44). Only one case was directly linked to the hands of an anesthesia provider before patient care.

**Conclusion** The surrounding environment was the most likely source of bacteria with which IV stopcocks were contaminated, although bacteria on patients and provider hands also contributed pathogens. Stopcock contamination was associated with infections and increased 30 day mortality. To reduce the risk of health care-associated infections, a multimodal approach will be needed to target the most common bacterial reservoirs; environment, provider, and patient.

**Comment**
I found the results of this study very sobering; although, I do not think the results are terribly surprising. Every day in the operating room we inject medications and we touch patients, anesthesia equipment, the anesthesia machine, and other materials hundreds of times a day. Despite our best efforts to wash our hands, use hand sanitizer, and wear gloves, we probably still contribute to the problem of IV stopcock contamination and thus to postoperative infections. It is probably impossible to completely eliminate all contamination. However, I think we all can certainly do a better job.

So what can we do to reduce the risk of IV stopcock contamination? Below I have compiled a list of some recommendations that may help.

1. Before beginning work, wash your hands and arms in the surgical scrub sink with an alcohol-based solution that contains 0.5%-1% chlorhexidine or similar solution prior to the start of patient care. Consider performing a “surgical scrub.”
2. Consider removing jewelry such as rings and watches during patient care.
3. Make sure your cleaning personnel are cleaning the anesthesia machine with an appropriate decontamination solution prior to the start of every case (i.e., quaternary ammonium compound such as Dimension III). Make sure they are targeting all parts and equipment on the anesthesia machine and monitors, especially the APL valve and vaporizer dials.
4. Always use gloves during patient care. When removing the gloves, immediately wash your hands with warm soap and water or use hand sanitizer with 62%-70% alcohol.
5. Wash your hands or use hand sanitizer after every patient interaction or when you suspect they were
contaminated. In this study IV stopcock contamination was reduced when providers used hand sanitizer more often.

6. Consider wiping off the stopcocks with an alcohol wipe prior to injection of medications. Keep the caps on the stopcocks when not in use.

7. Have a bottle of cleaning wipes (i.e., quaternary ammonium compound such as Dimension III) readily available to wipe down equipment if you contaminate it. For example, after intubation I wipe down the laryngoscope handle, APL valve, and vaporizer dial with one of these wipes and any time during the case if I feel I contaminated them.

8. At the end of each case make sure your cleaning personnel are cleaning the anesthesia machine, cart, and monitors with the appropriate cleaning solution or wipes. Consider gently reminding them, especially if you think the equipment is contaminated.

9. Do not reuse syringes. Throw them out once you have administered the medication. While this increases costs, it is in keeping with AANA safe injection practices. The syringes may serve as vectors for bacterial cross-contamination.

10. If you teach students or residents, review these practices with them. By role modeling good behaviors we can help ensure our future generations of anesthesia providers develop good infection control practices.

This list is not all inclusive; certainly there are other measures that CRNAs, surgeons, nurses, and patients can take to minimize the risk. However, I think some of these recommendations may help reduce the risk of IV stopcock contamination and postoperative infections.

Dennis Spence, PhD, CRNA

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
A meta-analysis of the use of nonsteroidal anti-inflammatory drugs for pediatric postoperative pain

Anesth Analg 2012;114:393-406
Michelet D, Andreu-Gallien J, Bensalah T, Hilly J, Wood C, Nivoche Y, Manzi J, Dahmani S

Abstract

Purpose The purpose of this meta-analysis was to look at the effect of combining opioids and nonsteroidal anti-inflammatory drugs (NSAIDs) in treating postoperative pain in pediatric patients. The specific factors analyzed were the effects of NSAIDs on dose of opioid used, the quality of analgesia, and the side effects.

Background The use of morphine for treatment of postoperative pain management is well established. Unfortunately, just as well known are the opioid-related side effects of respiratory depression, nausea and vomiting, pruritus, constipation, and urinary retention. Evidence has shown NSAIDs to improve postoperative pain relief in both adults and pediatric patients. With adults, the addition of NSAIDs results in an opioid-sparing effect, which might reduce the associated side effects. In the pediatric population, the reduction in the use of opioids when combined with NSAIDs is a matter of debate.

Methodology According to established guidelines, the researchers culled studies from two databases: PubMed and Embase. They searched on "name of the NSAIDs and children or infant." A manual search was also conducted for articles that were cited by the studies identified in the literature search. Studies were examined for relevance to the purpose and strict inclusion criteria were established, including: 1) postoperative opioid treatment in both groups, 2) a control group without NSAID treatment, and 3) standardized analgesia protocols. Studies were also screened for possible bias. The outcomes statistically analyzed were:

- quantity of opioid use
- pain quality
- nausea and vomiting (PONV)
- urinary retention
- pruritus

The adjusted standardized mean difference and the Mantel-Haenszel odds ratio (OR) were calculated for each outcome from each included study. The researchers also plotted outcome of published and unpublished studies to assess for publication bias, as a study producing negative results may have been less likely to have been published.

Result Originally 299 articles were identified related to NSAIDs and children or infants. Closer examination decreased the number of studies to 125. The examination for methodology bias and unusable results (outcomes in median and ranges) reduced the number of articles included in the meta-analysis to 27 randomized clinical trials. These studies included 567 patients receiving NSAIDs and 418 patients who did not.
Statistical analysis of the outcomes revealed that NSAIDs decreased opioid use in the postoperative care unit (PACU) and during the first 24 hours postoperatively. NSAIDs decreased pain quality or intensity in the PACU and decreased PONV in the first 24 hours. However, NSAIDs did not change the pain quality in the first 24 hours. Neither did NSAID use decrease PONV in the PACU. NSAIDs also did not decrease the incidence of pruritus or urinary retention.

The researchers further analyzed outcomes of subgroups of patients based on type of surgery (tonsillectomy and adenoidectomy versus orthopedic or general surgery) and timing of NSAID administration, intraoperatively vs. postoperatively. Pain intensity during the first 24 hours was no different in this sub-analysis based on type of surgery or timing of NSAID administration. However, subgroup analysis did show that the incidence of PONV was decreased in the first 24 hours postoperatively in patients who had tonsillectomy and adenoidectomy more than for other surgery types. This may have been due to the high risk of PONV in this patient population which may have been more responsive to opioid-sparing.

Finally, the analysis suggested a significant publication bias related to quantity of opioid use in the first 24 hours and level of pain intensity in the PACU. This suggested that some studies that found negative results related to these two outcomes may not have been published.

**Conclusion**

The overall outcomes of this analysis of 27 studies related to the effect of NSAIDs combined with opioids for postoperative pain management were:

- opioid-sparing effects in the PACU and in the first 24 hours
- decreased pain intensity in the PACU
- decreased PONV during the first 24 hours but not in the PACU

Adenotonsillectomy patients had reduced PONV for the first 24 hours. The outcomes also suggested that the combination of NSAIDs and opioids in the perioperative period had no beneficial effect on urinary retention or pruritus.

**Comment**

The stress effect of pain is well documented along with the negative side effects of opioids. This meta-analysis of studies looking at the combination of NSAIDs and opioids for postoperative pain management helps anesthesia providers untangle the evidence to support the use of NSAIDs. Especially when studies have different outcomes, a meta-analysis is very useful to gain more clarity in what the entire body of evidence suggests. This evidence suggests the combination of NSAIDs and morphine can have some beneficial effects such as decreased opioid required for analgesia and decreased PONV during the first postoperative day.

It is important to note that patients for whom NSAIDs were contraindicated were excluded from the studies included in this metaanalysis. Excluded were patients with risk factors such as: active bleeding, history of gastric ulcers, impaired renal function, or
severe asthma. Clinicians can use the positive information from this study, but must integrate foundational knowledge of NSAIDs and their indicated and contraindicated use. In my practice, the use of NSAIDs with tonsillectomy and adenoidectomy patients is restricted by surgeon preference due to the potential for postoperative bleeding.

It was interesting that the timing of the NSAID administration did not have an effect on the outcomes. The concept of preemptive analgesia suggests early administration to minimize the stress response to pain. However, the two time points identified were intraoperative and postoperative. I would be interested to seek further information related to preoperative administration, and I would suggest that negative outcomes such as increased bleeding would need to be analyzed as well.

The specific NSAIDs administered in the studies included in this metaanalysis were not specified. The original search included both selective and non-selective cyclooxygenase inhibitors. The number of studies would likely have been reduced if the researchers had been more selective in the drugs used in the included studies; however the outcome might be more applicable clinically. In my clinical practice, the use of NSAIDs is incorporated into even minor cases such as myringotomy cases with excellent results. Especially in outpatient surgery centers were patients are monitored for a relatively brief time postoperatively, the benefits of NSAIDs when combined with opioids can reduce inconveniences and increase patient and family satisfaction.

Terri M. Cahoon, DNP, CRNA
Pharmacology

**Nitrous oxide and long-term morbidity and mortality in the ENIGMA trial**

Leslie K, Myles PS, Chan MTV, Forbes A, Paech MJ, Peyton P, Silbert BS, Williamson E

**Abstract**

**Purpose**  The purpose of this study was to compare outcomes in patients who received nitrous oxide during their general anesthetic with those who did not. The primary outcome was survival. Secondary outcomes included the incidence of myocardial infarction (MI), stroke, and plasma homocysteine levels.

**Background**  Nitrous oxide has long been known to inactivate methionine synthase. This results in a dose-dependent increase in plasma homocysteine. Elevated plasma homocysteine damages vascular endothelium and may disrupt coronary arterial plaques, if present. Homocysteine may also favor atherosclerosis and thrombus formation. Thus, there may be a link between nitrous administration and cardiovascular morbidity and mortality.

The ENIGMA trial randomized over 2,000 patients scheduled for non-cardiac surgery lasting more than two hours to receive general anesthesia including nitrous oxide or nitrous free general anesthesia. Postoperatively, the patients who received nitrous oxide were more likely to die or have a myocardial infarction (MI). They also had increased homocysteine levels. Nevertheless, methodological problems prevented the investigators from linking nitrous oxide use to these cardiovascular complications. Chief among them, the nitrous group received 70% nitrous and 30% oxygen while the control group received 80% oxygen and 20% nitrogen. Also, other cardiovascular risk factors were not controlled for.

**Methodology**  This was a secondary analysis of the original ENIGMA data collected between April 2003 and November 2004. Additional data was gathered from patient or family interviews and medical records. In an effort to better determine any possible link between nitrous oxide and cardiovascular morbidity and mortality the analysis was adjusted for patient variables such as age, gender, weight, ASA physical status, preoperative coronary artery disease, anemia, emergency surgery, and abdominal surgery. The analysis was also adjusted for technique variables including propofol maintenance, MAC equivalents of potent inhalation agent, and duration of anesthesia. Data was not collected about intraoperative hemodynamics or anesthetic depth.

**Result**  The number of years patients could be followed postoperatively varied between 0 and almost 6 years. The median follow-up period was 3.5 years. Follow-up was successful in 83% of patients, but interviews were successful in only 1,290 patients. The
interviewed patients were split almost exactly 50%: 50% on nitrous oxide administration. Patients with complete interviews were included in the secondary analysis. Only 11% of patients in the secondary analysis reported a history of coronary artery disease and 4% reported a history of stroke.

Overall survival was unaffected by nitrous oxide administration (P=0.82). Postoperative death was more likely in patients with any of the following characteristics:

- increased age
- male gender
- abdominal surgery
- propofol maintenance
- less than 0.75 MAC equivalents
- longer duration of anesthesia

Nonabdominal surgery patients who did not receive nitrous oxide were 36% less likely to die during the postoperative follow up period than those who had received nitrous. This effect was not seen in patients who underwent abdominal surgery.

The adjusted odds of a postoperative MI in patients who received nitrous oxide were 1.59 (P=0.04). The greatest risk of a postoperative MI was in greater than 49 year olds. No increased incidence of postoperative MI was seen until the duration of nitrous oxide exposure was greater than 4 hours. And, in fact, 2.5 to 3.9 hour exposure actually had a lower incidence of MI (OR 0.81). The odds of a postoperative stroke were no different between patients who received a nitrous and nitrous-free anesthetic (OR 1.01, P=0.97). In patients who subsequently had an MI, postoperative plasma homocysteine levels were significantly increased compared to their preoperative level, and homocysteine levels were more commonly elevated above the normal range in patients who subsequently had an MI.

Conclusion

Compared to general anesthesia with 80% oxygen, administration of 70% nitrous oxide was associated with a clinically important, but just barely statistically significant, increase in the long-term incidence of myocardial infarction. The rates of stroke and overall death rates were not increased in patients who received nitrous.

Comment

I’m fairly conservative when interpreting research and I’ll admit that my mindset has been biased towards needing pretty strong evidence before I decide nitrous oxide use should be significantly
reduced or eliminated. But I’ve been ruminating over this study and it needs some further comment. Even in this secondary analysis there is a lot of information that simply isn’t supported strongly enough for me to run out and change my practice. But … there are also some questions raised that shouldn’t be ignored. And there is evidence for a few points that is strong enough that I believe I should change my practice at least until more complete information is available.

Here are some things we know from previous research:

- Methionine synthase is inactivated by nitrous oxide in a dose dependent manner.
- Inactivating methionine synthase results in increased plasma homocysteine.
- High levels of homocysteine increase the risk of atherosclerosis and thrombosis.
- High levels of homocysteine are associated with cardiovascular disease.

Now this alone doesn’t necessarily mean nitrous oxide is going to cause cardiovascular disease. But it may, at the least, contribute to higher homocysteine levels that, over time, increase the risk of cardiovascular disease. The data from the original ENIGMA study (and the secondary analysis) is inconsistent on points like this. For example, if nitrous oxide exposure during a general anesthetic increased later cardiovascular risk through increased plasma homocysteine, one would expect there to be a dose dependent component to it. But in figure 2 we see that exposure to 70% nitrous oxide for between 2.5 hours and 3.9 hours appeared to decrease the odds of having an MI later on compared to those who did not receive nitrous. Conversely, exposure to 70% nitrous for over 4 hours was associated with almost twice as many postoperative MIs. This data doesn’t appear to fit together. If nitrous has a causal relationship with later MI, slight exposures to nitrous might not increase the risk of MI, but no level of exposure should reduce the risk of an MI.

So what’s the bottom line? While we have to wait and hope the ENIGMA-II study will give us much better answers to some of the questions raised by the original ENIGMA study, here is my personal take.
from what I know now. Please view these statements as informed opinions, rather than “truth.”

Here is why I am so skeptical about so much of the information in this secondary analysis of the ENIGMA study:

‣ Follow up was incomplete - between 0 and 5.7 years.
‣ Inconsistency in the risks of MI & death. If cardiovascular risk is increased I’d expect MI & death rates to be associated.
‣ No Increase in Stroke Rates.
‣ Methodological problems in the study.
‣ The problem, increased homocysteine causes cardiovascular disease, appears to be chronic – N₂O administration is acute event.

But there are other areas where the data appears to be consistent and the evidence is fairly strong and clinically significant. Probably the strongest and most clinically important examples are the rates of postoperative death and myocardial infarction after 4+ hours exposure to 70% nitrous oxide (figure 1). Due either to strong evidence or significant associations I wouldn’t use nitrous oxide in the following circumstances at least until ENIGMA-II reports better information:

‣ Anesthetics longer than 4 hours (2 hours if your really conservative)
‣ Patients with cardiovascular disease
‣ ASA 3 or 4 patients

When ENIGMA-II results become available we’ll have them here for you ASAP.

Michael A. Fiedler, PhD, CRNA

For a more complete discussion of this topic, consider attending the online webinar, “Nitrous Oxide: the ENIGMA Trials” available on CRNAwebinars.com. 1 CE credit.
Preoperative dexamethasone enhances quality of recovery after laparoscopic cholecystectomy

Anesthesiology 2011;114:882-890
Murphy GS, Szokol JW, Greenberg SB, Avram MJ, Vender JS, Nisman M, Vaughn J

Abstract
Purpose  The purpose of this study was to compare recovery characteristics in laparoscopic cholecystectomy patients with, and without, the preoperative administration of 8 mg dexamethasone.

Background  Laparoscopic cholecystectomy is a common surgery. Patients are often discharged home shortly after the procedure is completed, making the quality of recovery a crucial factor in a patient’s overall comfort and satisfaction. Dexamethasone has been shown in some studies to contribute to a reduction in PONV after laparoscopic procedures, reduce postoperative pain, increase feelings of well being, decrease fatigue, and reduce sore throat associated with endotracheal intubation. Since dexamethasone has an onset of 1 to 2 hours, when it is administered may be crucial to producing some or all of these outcomes. Shorter times between dexamethasone administration and start of surgery may account for the failure of some studies to demonstrate these beneficial effects.

Methodology  This was a randomized, double-blind, placebo-controlled study in patients who had laparoscopic cholecystectomy with general anesthesia. Approximately one hour before incision Decadron patients received 8 mg dexamethasone IV over at least 60 seconds. Control patients received an equal volume of saline. All patients had a general anesthetic with midazolam, propofol, muscle relaxant (succinylcholine and/or rocuronium), fentanyl, and sevoflurane. All patients received 4 mg ondansetron 30 minutes prior to the end of the case. Trocar insertion sites were infiltrated with bupivacaine in both groups.

The primary tool used to assess quality of recovery was the 40 item “Quality of Recovery” instrument (QoR-40). Each item in the QoR-40 was a question answered on a five-point Likert scale [1=poor … 5=excellent]. The QoR-40 has been validated in a number of types of surgical patients. QoR-40 results 24 hours postoperatively was the primary outcome measure. A second survey was administered to capture symptoms related to steroid side effects. Pain was assessed with a 100 mm visual analog scale (VAS). QoR-40 data was “averaged” [emphasis by editor] and analyzed with a t test. Categorical data was analyzed with the Fisher’s exact variant of the chi squared test.

Result  After five patients were converted to open cholecystectomies and excluded from the study, 91 patients remained in the analysis (46 Decadron group, 45 Control group). There were no significant differences in demographics, medical history,
anesthetic technique, or duration of anesthesia between groups except for a higher incidence of preexisting hypertension in the Decadron group. There was no difference between groups in the incidence of adverse events that might be attributed to decadron.

The incidence of postop nausea was lower in the Decadron group [despite the fact that all patients received ondansetron] (12.5% vs. 37%, P=0.003). Decadron patients were 67% less likely to be treated for PONV in the Ambulatory Surgery Unit (P=0.001). Likewise, Decadron patients were treated for pain less often than Control patients while in the PACU (71% vs. 97%, P<0.001) and their pain was relieved with lower total doses of hydromorphone (P<0.001). But, once in the Ambulatory Surgery Unit, there was no difference in pain, or the need to treat pain, between the Decadron and Control groups. Twenty-four hours postoperatively, the Decadron group had higher QoR-40 scores, indicating a higher “quality of recovery” compared to Control group patients (QoR-40 scores 178 vs. 161, P<0.001). Lastly, time to discharge was also less in Decadron patients, 1 hour 37 min vs. 4 hours 25 min (P=0.009).

**Conclusion**  Dexamethasone 8 mg IV approximately one hour before incision for laparoscopic cholecystectomy resulted in less nausea postoperatively and a reduction in pain while in the PACU. Quality of Recovery scores were somewhat improved in the Decadron group and discharge times were significantly shorter.

**Comment**

I think we are beginning to understand that dexamethasone can be a real friend to anesthesia in many patients. And, I’ll admit, going into this study, I expected it was going to show that Decadron did all sorts of good things for lap chole patients. I already believed it clinically. I’ve experienced it both as a patient and as an anesthetist. And all that may be true, but this study didn’t provide the evidence to convince me my observations were correct.

Unfortunately, it suffers from several common analytical mistakes and, in my view, the investigators were a little too enthusiastic in their interpretation of the results.

So, was there anything I could believe in this study? Yes. Here is what I took away from it after winnowing out the chaff:

- The Decadron group had significantly less nausea; 67% less than Control patients in the Ambulatory Surgery Unit. This difference was highly statistically significant and was analyzed properly. While this effect is not unsurprising, the magnitude of the reduction in postop nausea makes me ask if we shouldn’t be giving Decadron to all lap chole patients unless there is a reason not to.
- The Decadron patients were clearly ready for discharge much sooner than Control patients. This difference was highly statistically significant and was analyzed properly. This ultimate outcome criteria, how quickly patients could be discharged, may be the best evidence of the Quality of Recovery.

That said, the study was less convincing in the areas of:

- Pain
- Quality of Recovery
The study assessed pain with a Visual Analogue Scale, as is commonly done. They produced “statistically significant results.” But, in my opinion, the investigators made several mistakes. Patients don’t seem to perceive pain linearly; not like a ruler where the difference between 1 inch and 2 inches is the same as the difference between 5 and 6 inches. VAS scores are ordinal data but they analyzed this data as if it were much higher quality, interval data. Also, the difference in pain reported between groups really wasn’t that great from a clinical perspective; less than 10%. And the confidence interval included zero so I’m not even sure of that 10% difference. Is that clinically significant, even if it was analyzed correctly? I don’t think so. Nevertheless, Decadron patients were treated less often for pain by nurses who didn’t know what group they were in, and they needed less opioid to relieve their pain. This pain treatment data was analyzed correctly and was highly clinically and statistically significant. I accept it as evidence that Decadron probably did result in better pain management, at least while patients were in the PACU.

Next to Quality of Recovery and the QoR-40 tool. This is a valid tool to assess the recovery experience of a patient. But again, it is not high level data; it is ordinal data. Averaging this data is like averaging what order runners finished a race in. It really doesn’t mean anything. This data, too, was analyzed improperly with a t test. But, that said, the results achieved such high statistical significance that my educated guess is that the differences in QoR-40 scores would likely have been significant if they had been analyzed properly. So I ask the clinical question. Is the difference between a QoR-40 of 178 and 161 clinically significant? (Maximum value = 200. Higher numbers are better quality of recovery.) Statistically significant, probably. Clinically, I’m doubtful. Please understand, however, Decadron may actually make people feel better. I’m only saying this study didn’t show it.

Lastly, and perhaps most importantly, this study raised a question in my mind that has profound ethical considerations. One I’ve never thought of before. I think the biggest finding from this study was that Decadron patients were discharged about an hour sooner than Control patients. If that’s true over a wide range of patients it’s huge. Every patient out the door an hour sooner? Think of the money that would save! So, then I’m thinking, “could there be institutional pressure to give everyone Decadron to get them out the door sooner and save money?” Now I’m not saying there would be, nor am I trying to disparage administrators in general. But I do think this raises a question we need to think about. How do we make sure there is a decision making process in place that is based solely upon patient considerations and excludes institutional considerations? How do we make sure we aren’t “pressured” into giving Decadron when we wouldn’t otherwise? Something to think about.

Michael A. Fiedler, PhD, CRNA